Thus the formula agrees well with the equations of condition. With regard to individual errors, they depend upon errors of observation and upon anomalies in the intensities of terrestrial gravity; but it is difficult to discover in the differences given above any certain traces of these anomalies and of the local causes which produce them.

"In the work of W. Struve on the arc of meridian between the Danube and the Arctic Sea is a detailed discussion of the latitudes of the principal places between the North Cape and the Danube. The differences in latitude found directly from the astronomical observations vary only $\pm$ 1″·75 from those deduced from the geodetical operations. Although these differences are very much larger than the errors of observation, they are not as great as those which may be found in corresponding operations in other countries. Our stations are in the neighbourhood of the places discussed by M. Struve; so that it appears that in the great plains of Western Russia the directions and intensities of gravity are not subject to anomalies which change sensibly from one of our stations to another."

On the Physical Changes in Jupiter. By A. C. Ranyard, Esq.

It was suggested at one of the recent meetings of the Society, that if *Jupiter* had at any time been studied with sufficient optical power the same details would always have been apparent, and it was hinted that much which individual observers had been disposed to record as changes occurring upon the surface of *Jupiter*, was really to be attributed to the increased power of the instruments used.

In answer to such objections I propose to compare a small series of drawings, all made within the last twenty years, by well-known observers and with large instruments.

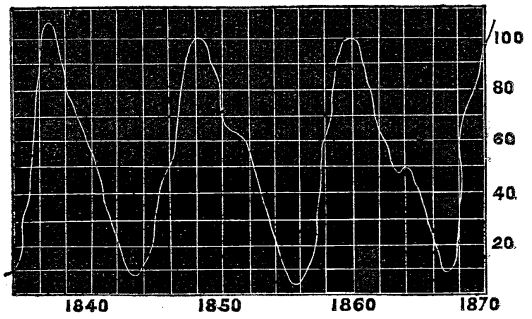
We will commence with a drawing by Mr. Lassell, a very poor woodcut from which is given at page 134 of vol. x. of the *Monthly Notices*. It was taken with his 20-feet reflector and 24 inches aperture. *Jupiter* is there represented within two years of the great Sun-spot maximum of 1848, and the strongly-marked white spots in the southern belts, and the broken condition of the equatorial region, are very apparent.

Within a year of the next Sun-spot minimum Mr. W. De La Rue made his large and well-known drawing of *Jupiter* with a 13-inch silver speculum. Its date is October 1856, and his engraving, which was largely circulated, was at that time universally acknowledged to be a very just representation of the state of the planet. It is full of the smallest details in the belts, yet there are no traces to be found of Dawes' markings, bright points, northern or southern eggs, or equatorial port-holes.

A second drawing, made in 1856 by Piazzi Smyth on *Teneriffe* with a $7\frac{1}{4}$-inch refractor, when *Jupiter* was near the zenith,

entirely endorses that of Mr. W. De La Rue. The next Sun-spot maximum occurred at the end of 1859; and in Nov. 1858, Mr. Lassell again noticed and figured the Dawes' markings and white spots. He says, at page 52 of the *Monthly Notices*, vol. xix., "One of the most novel features I noticed was the existence of a numerous group of white spots in the bright equatorial region, far more delicate and difficult to see than those in the southern hemisphere, which I first noticed in March 1850. For several years I failed to see any such spots upon the face of *Jupiter* at all, but last year they appeared again in the same quarter of the planet, and were attentively and ably observed by Mr. Dawes."

In September 1859 the flocculent cloudy port-holes in the principal belts made their appearance and were beautifully drawn by Sir J. Keith Murray with his 9-inch refractor. They remained more or less a marked feature of the central belt till the end of 1861, and were figured by many observers with telescopes varying from 5 inches in aperture and upwards — though they are not to be found in a very elaborate series of drawings made by Mr. Gorton with a $3\frac{1}{2}$-inch Cook in the years 1860–1861.



I cannot here omit to quote a remark made by the Astronomer Royal in his Report to the Visitors of the Greenwich Observatory for the year 1860–61. Speaking of the great Equatoreal, he says, 'It has been employed to a considerable extent in the preparation of delineations of *Jupiter* and *Mars*. The former of these planets has exhibited in the last year some appearances never before recorded; and it has appeared very desirable to register as soon as possible anything which seems to indicate a change in the constitution of that great body."

Mr. Carpenter during that year made a series of most careful drawings, showing all the flocculent port-holes and reddish colour of the equatorial region, bright eggs, and elliptic markings, which have been so noticeable during the last two years.

The next minimum of Sun-spots occurred early in 1866.

I have been able to find very few drawings of *Jupiter* in or near to this year, and my conclusion is, that there must have been but few conspicuous bright or flocculent markings to attract attention.

The Rev. T. W. Webb has been so good as to examine his

observatory note-books for drawings of *Jupiter* from 1863 to 1867. He only finds two drawings during this period with anything like white egg markings; the first on June 23, 1863, and the second in August 1866, with two white spots; one in a southern, the other in a northern belt; but he thinks that they have evidently nothing to do with the egg markings of 1860–1870.

It is unnecessary here to give any account of the reappearance of the same phenomena during the recent Sun-spot maximum. I append a Sun-spot curve for the period 1834–1870.

On account of the interest attached to the question of the variability of the Nebula of *η Argûs*, the Council have determined to print as well Mr. Abbott's communications as the remarks upon them by the late Sir J. F. W. Herschel, and the Astronomer Royal. For convenience of reference it may be mentioned that Mr. Abbott's former papers are printed in the *Monthly Notices*, vol. xxi. p. 230 (June 1861); vol. xxiv. p. 2 (November 1863), with plate; vol. xxv. p. 192 (April 1865, paper dated 18th February); and vol. xxviii. p. 200 (May 1868, paper dated 29th February), with a plate; and that there is a paper by Sir J. F. W. Herschel, vol. xxviii. p. 225 (June 1868); and one by him and Lieut. Herschel, vol. xxix. p. 82 (January 1869), with five plates.—Ed.

Some further Observations on the Variable Star η Argûs, and its Surrounding Nebula. By F. Abbott, Esq.

I now forward to the Society, after a period of two years, a third drawing,* with some remarks in reference to more recent observations on the inequality of motion, and variation in aspect of *η Argûs*, and the surrounding Nebula.

On my last communication some critical remarks were made, with a view of disproving that which I never intended to prove. This, in all probability, arose from my not having expressed myself with sufficient clearness in my remarks on the drawing which accompanied the observations. In this way the road to truth often runs through the midst of error, but that does not in any way alter the fact that great changes have been, and still are, taking place in the object under consideration.

Perhaps the field given in the drawing of 1868 may be somewhat too large, as it was my first intention to have made it larger; but, finding that the changes were principally confined to η and the so-called Lemniscate,† I confined the drawing to the size of the field given with the eye-piece.

* See plate of *η Argûs* as taken Jan. 28, 1870.—Ed.

† I scarcely think this term a good one:—Lemniscate, or Lemniscus; a curve formed as the figure 8, or a bow tied of a riband—Barlow and B. H. Smart. Such a curve is closed in the centre, which is not the case in the Cape drawing, it being there shown as a long enclosure slightly compressed in the centre. It was in this compressed part that the star η appeared when out of the dense Nebula.